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Electronics for Scientists

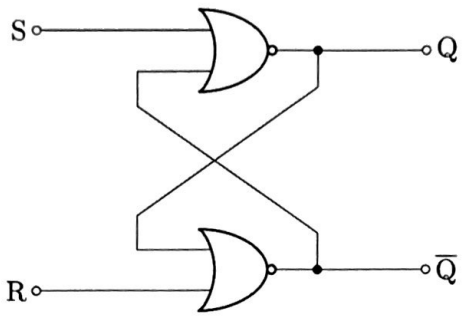
Flip Flops

Instructions

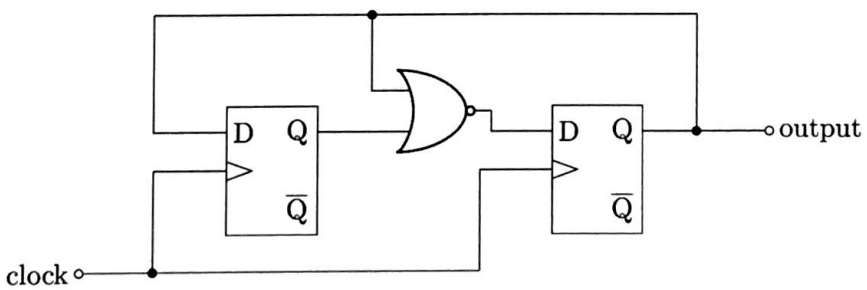
Complete the following exercises to the best of your ability. Don't forget units and show your work! Answers without units or supporting work will be graded incorrect.

1. Design a circuit using logic gates that adds two bits in binary, i.e. $0+0=0$, $0+1=1$, $1+0=1$, and $1+1=10$. This circuit will have two inputs and two outputs (1 for each bit).

2. Describe the operation of the below circuit, shown below.



3. The following circuit is driven by a clock input. Create a timing diagram of the clock and output. It will likely also be helpful to create timing diagrams of the outputs of the first flip flop and the output of the NOR gate.



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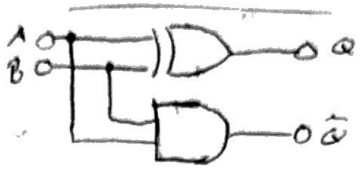
P1.

0+0 = 0
1+0 = 1
0+1 = 1
1+1 = 0

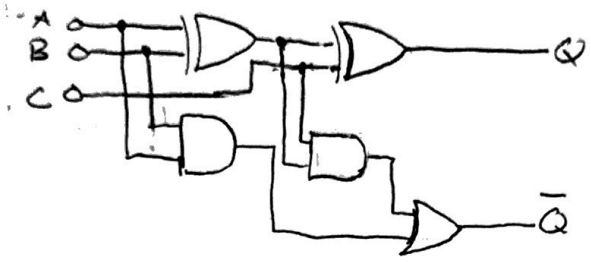
Half Adder



✓

A	B	Q	$\bar{Q}$
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Full adder



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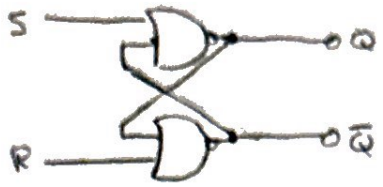
P2:



SR-Latch

The above circuit is a flip flop circuit. The NOR gates take in two inputs and the corresponding output is the inverse. So if the output is a "1" from S, it will be flipped to "0". When S=1, it saves Q=1, when R=1, $\bar{Q}$=0 and S=0 and resets. This is a one bit computer.

can you show this step by step

using the logic gates

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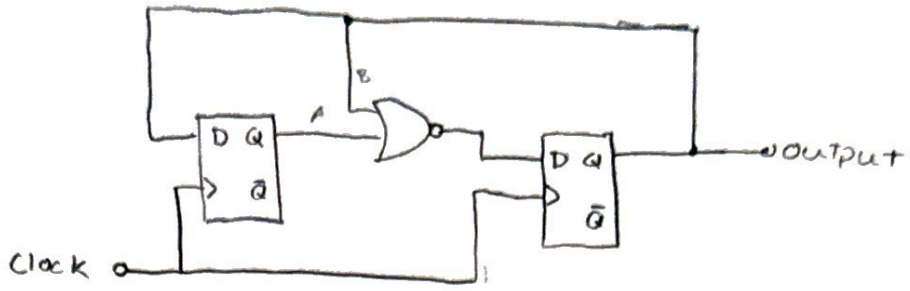
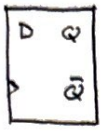
P3:



D-Flip Flop

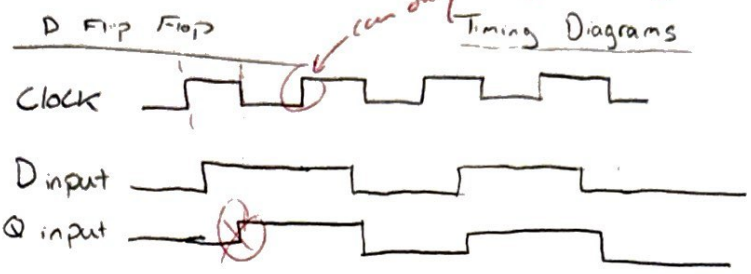


D	Q	Q̄
0	0	1
1	1	0

NOR Gate

B \ A	0	1
0	1	0
1	0	0

Q



NOR gate is only on when both inputs are 0, so when D is low from the first flip-flop, the output of the NOR gate will be one and the output will look as follows

output